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Source: *The Academy of Management Journal*, Vol. 40, No. 6 (Dec., 1997), pp. 1282-1309

Published by: [Academy of Management](#)

Stable URL: <http://www.jstor.org/stable/257034>

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# TEACHING EFFECTIVENESS IN TECHNOLOGY-MEDIATED DISTANCE LEARNING

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**Technology-mediated distance learning is becoming increasingly important to business curricula. However, little theoretical development or empirical research has examined teaching effectiveness in distance learning. Thus, this article draws from research in management communications, education, and information systems to develop an initial conceptualization of influences on technology-mediated distance learning outcomes. It then reports on an exploratory study utilizing both qualitative and quantitative techniques to examine 247 students' reactions to such distance learning.**

Rapid developments in information technology (IT) have generated potential changes to teaching and learning. In particular, technology-mediated distance learning—a new method of distance education—is currently in use. It can be described as learning involving implementation of information, computing, and communications technology applications (Alavi, Wheeler, & Valacich, 1995) in more than one location.

Schools of business are adopting technology-mediated distance learning for undergraduate business cases and simulations and for employment interviews (Hildebrand [1995] noted these practices at Texas Christian University), for master of business administration (M.B.A.) courses (e.g., University of Maryland; Alavi et al., 1995), and for executive M.B.A. programs (e.g., Queen's University; *State of the Art MBA in Canada*, 1995), and these applications are occurring around the world (cf. *PictureTel Distance Learning*, 1996). However, if students rate the effectiveness of teachers as lower in these courses than in conventional courses, then instructors and administrators will want to know why this is so and what they can do to help overcome limitations of the technology.

Technology-mediated distance learning is becoming an important op-

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We thank Patricia Delmore-Ko for her able research assistance, the many students and faculty and staff members who contributed their time and ideas to this study, and the reviewers of this special research forum for their constructive suggestions. University of Waterloo and Social Sciences and Humanities Research Council grants provided financial support for this study. The second author was a master's degree candidate at the University of Waterloo when this research was conducted.

tion within education because it facilitates the sharing of costs, information, and expertise among multiple sites while providing additional educational opportunities for distant or disadvantaged locations. Another advantage of using information technology in education is that students are introduced to and take advantage of the very technologies that businesses are using to gain competitive advantage (Leidner & Jarvenpaa, 1993). Business schools are under increased pressure to graduate students with experience with these emerging technologies (Alavi et al., 1995; Hildebrand, 1995). Further, administrators see the cost benefits of adopting these technologies and the strategic advantages of penetrating new market segments (Walsh & Reese, 1995) and are encouraging their use by faculty members. Thus, it is important to develop a fuller understanding of the impacts of these technologies within education today.

A typical distance learning implementation may utilize information technology to provide audio, video, and graphic links between two or more sites, therefore using multimedia for communication. Collis described multimedia education as involving "more than one medium for the organization, information exchange, and interactive aspects of the learning experience" (1995: 136). However, little research has addressed reactions to multimedia when they are employed for communication (Chidambaram & Jones, 1993) and in distance learning in particular (Alavi et al., 1995; Ellis, 1992; Latchem, Mitchell, & Atkinson, 1994). Thus, researchers have called for the development of models and methodologies for the study of technology-mediated distance learning (Cleveland & Bailey, 1994; Storck & Sproull, 1995). This article makes a start toward achieving this goal.

In this article, we draw from research in the management communications (e.g., Fulk, 1993), education (e.g., Collis, 1995), and information systems (e.g., Leidner & Jarvenpaa, 1995) literatures to develop an initial conceptualization of key technology-mediated distance learning outcomes relating to teaching effectiveness and of factors that may influence these outcomes. We then report on an exploratory study utilizing both qualitative and quantitative techniques to examine teaching effectiveness through students' reactions to technology-mediated distance learning.

## DEVELOPMENT OF HYPOTHESES

### Technology-Mediated Distance Learning Outcomes

Student performance represents a key aspect of teaching effectiveness. However, reviews of research comparing the effectiveness of educational television and face-to-face instruction have found no or small differences in student achievement (Wetzel, Radtke, & Stern, 1994), and a recent distance learning study (Storck & Sproull, 1995) found no differences between the performance of students given interactive video instruction and face-to-face instruction. Cleveland and Bailey argued that distance learning studies "need to move beyond the limited perspective of class grade point averages as indicators of program quality and student learning" (1994: 140). Following this suggestion and Leidner and Jarvenpaa's (1995) taxonomy of learning

outcomes, we examined such outcomes relating to teaching effectiveness as student involvement and participation, cognitive engagement, technology self-efficacy, attitudes toward the technology employed, the usefulness of the technology, attitudes toward technology-mediated distance learning, and the relative advantage or disadvantage of such distance learning.

The education literature suggests that the first two outcomes are particularly important to teaching effectiveness. As Leidner and Jarvenpaa (1993) and Alavi and colleagues (1995) outlined in their reviews of the learning literature, learning is best accomplished through the active involvement of students. Similarly, educators proficient with technology-mediated distance learning have argued that instructors must generate student involvement for courses to be successful (Catchpole, 1993; 1995) videoconference because a common problem with this pedagogy is difficulty eliciting student involvement beyond passive note taking (*Introduction to Video Mediated Communication*, 1995).

Designing courses to be engaging encourages and facilitates learning (Adelson, 1992; Hsi & Agogino, 1993) and is vitally important in distance education (*Introduction to Video Mediated Communication*, 1995). For instance, Cleveland and Bailey (1994) found that although 91 percent of the students participating in a course taught via distance education expected the class to be intrinsically interesting and enjoyable, at the end of the course only 9 percent of the students suggested that the technology made the class more interesting. Although some preliminary research has examined characteristics of multimedia technologies encouraging student engagement, this research has examined situations in which students interact individually with the technologies (e.g., Bruce, Peyton, & Batson, 1993; Jacques, Preece, & Carey, 1995). In contrast, little research has examined the effects of multimedia technologies on student engagement during instructor presentations.

Several other outcomes relate to teaching effectiveness. First, the social cognitive theory (Bandura, 1986) concept of self-efficacy is relevant. Compeau and Higgins suggested that "the belief that one has the capability" to interact with a given technology (1995: 189) plays a significant role in users' expectations and performance. Consistent with social cognitive theory, students' technology self-efficacy may be an important outcome variable within technology-mediated distance learning. Second, students' opinions regarding technology and distance learning may have significant effects on the success of the method. Researchers have generally argued that the successful implementation of any new technology depends on factors related to users' attitudes and opinions (e.g., Davis, Bagozzi, & Warshaw, 1989; Zoltan & Chapanis, 1982). Therefore, we suggest that attitudes toward a technology, the perceived usefulness of the technology, and attitudes toward distance learning should be included as important learning outcomes. Finally, it is also important to include students' perceptions of the relative advantage (Moore & Benbasat, 1991) or disadvantage of distance learning, or a comparison of distance learning with traditional face-to-face instruction. That is, although students may have positive attitudes toward technology-mediated

distance learning, they may also believe that this form of learning is not as beneficial as a conventional classroom setting.

### **Influences on Outcomes of Technology-Mediated Distance Learning**

Following Dillon and Gunawardena's (1995) framework for evaluating technology-mediated distance learning and Leidner and Jarvenpaa's (1993) model of learning in electronic classrooms, we examined four categories of influences on distance learning outcomes: technology, instructor, course, and student characteristics.

**Technology characteristics.** We propose that reliability, quality, and medium richness are key influences on learning outcomes. Technology reliability and quality are important attributes of task-technology fit (Goodhue & Thompson, 1995), and they will be especially important for a newer technology such as multimedia. In particular, participants in desktop videoconferencing presentations (Isaacs, Morris, Rodriguez, & Tang, 1995) and distance learning courses (Wetzel et al., 1994) often complain about poor video quality and audio-video synchronization. Reliability of the technology used is especially important when instruction is centered around the technology (Sandholtz, Ringstaff, & Dwyer, 1992): without the technology, there is no instruction to the remote sites. Thus,

*Hypothesis 1. The reliability of the technology used in distance learning should relate positively to learning outcomes.*

*Hypothesis 2. The quality of the technology used in distance learning should relate positively to learning outcomes.*

The perceived richness of multimedia technology should also influence learning outcomes. In medium richness theory (Daft & Lengel, 1986), a rich medium is one that conveys multiple verbal and nonverbal cues, allows for immediate feedback, uses natural language, and allows personal focus. Daft and Lengel created a hierarchy of medium richness, with face-to-face communication at the top, followed by telephone, electronic mail, and print communications. There has been some debate in the literature about whether richness is an inherent, objective property of media (as originally proposed) or whether it should be considered a perceptual phenomenon. According to the latter perspective, which has been suggested by social influence theorists (and is discussed below), different people in different social contexts perceive media differently.

Technology-mediated distance learning often incorporates interactive (either compressed or full-motion) video;<sup>1</sup> however, we expected it to be per-

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<sup>1</sup>The quality of full-motion video is similar to that of television: there are no perceptible audio or video lags. With compressed video, there is a lag; for the equipment used in the classrooms providing data for this study, the lag was about one second.

ceived as less rich than face-to-face instruction for the following reasons: First, although the use of multimedia has not been the subject of enough research to place it on the richness hierarchy, researchers have considered it as falling below face-to-face instruction (Kydd & Ferry, 1994; Nahl, 1993). For example, comparing face-to-face, distributed synchronous, and distributed asynchronous groups, Burke and Chidambaram concluded that "bandwidth does make a difference: richer interaction environments elicit perceptions of greater social presence and communication effectiveness than more restrictive environments" (1996: 99–100). Second, students interact more passively with interactive video than they do with face-to-face instruction; this may be the result of a cultural association between interactive video and broadcast television (Storck & Sproull, 1995). For instance, research has demonstrated that both local and remote audiences pay less than full attention to interactive video presentations (Isaacs et al., 1995), that presenters speak more formally, and that listeners are less likely to provide aural feedback to speakers (O'Conaill, Whittaker, & Wilbur, 1993). Therefore, we propose:

*Hypothesis 3a. Students will perceive the technology used in distance learning to be a less rich medium than traditional, face-to-face instruction.*

We also propose that students at remote locations will perceive the technology to be leaner than those at origination (that is local, or face-to-face) locations, because those at the origination points have the benefit of both the face-to-face instruction and the technology. More information is available to local students about the material and the teachers, and more interaction occurs (Storck & Sproull, 1995). Thus,

*Hypothesis 3b. Students at origination sites will perceive the technology used in distance learning to be richer than those at remote sites will perceive it to be.*

Full-motion video is more similar to face-to-face instruction than is compressed video. Compressed video's transmission delays make students reluctant to contribute brief remarks and may result in blurred or jerky images and less accurate impressions of others (Storck & Sproull, 1995). Therefore,

*Hypothesis 3c. Students in courses using full-motion video will perceive the technology used in distance learning to be richer than students in courses using compressed video will perceive it to be.*

Perceived medium richness is proposed to be associated with people's attitudes toward and use of media (Fulk, 1993; Fulk, Schmitz, & Ryu, 1995): the richer a medium is perceived to be, the more likely it will be preferred and used for any communication task (Schmitz & Fulk, 1991). Similarly, teacher immediacy, or accessibility "through verbal, paralinguistic, visual, and/or physical means" (Ellis, 1992: 7) will be higher with richer media and will result in more motivated and attentive students. Thus, we propose:

*Hypothesis 3d. Students will report higher learning outcomes to the extent to which they perceive the technology used in distance learning to be rich.*

**Instructor characteristics.** Collis concluded her review of the education literature concerning the impact of media with this observation: "It is not the technology but the instructional implementation of the technology that determines its effects on learning" (1995: 146). We propose that instructors' attitudes toward a technology, teaching styles, and control over the technology will affect learning outcomes.

Dillon and Gunawardena (1995) proposed that instructors' attitudes toward technology-mediated distance learning systems be included in evaluations of these systems. This view is consistent with Fulk, Schmitz, and Steinfield's (1990) social influence model of technology use, according to which social influences such as work group norms and co-worker and supervisor attitudes and behaviors can positively or negatively influence attitudes, media use, and choices. Perceptions of media are proposed to vary and to be, at least in part, socially constructed in organizations. The social psychological processes that are used to explain this likely phenomenon include social learning (Bandura, 1986) and social information processing (Salancik & Pfeffer, 1978). Organization members are expected to develop coordinated patterns of behavior based on observations of each others' behaviors, the consequences of behaviors, and emotional reactions (Fulk, 1993). A number of studies have empirically supported the social influence model, finding that attitudes toward and use of e-mail were affected by social influences from co-workers and supervisors (Fulk, 1993; Schmitz & Fulk, 1991). We propose that the same influences will occur in technology-mediated distance learning. Thus,

*Hypothesis 4. To the extent that instructors have positive attitudes toward the technology used in distance learning, students will be likely to experience more positive learning outcomes.*

The teaching style of an instructor—specifically, encouraging student interactions—should also affect learning outcomes for the following reasons. Interaction is key to all learning (Dillon & Gunawardena, 1995) and to learning with multimedia (Collis, 1995) and distance (Borbely, 1994; Latchem et al., 1994) technologies in particular. It is even more important to technology-mediated distance learning because of the "remote" feel of the interaction (*Introduction to Video Mediated Communication*, 1995). Without significant interaction, students may become easily distracted, making side comments to one another (Gowan & Downs, 1994) and giving part of their attention to other activities (Isaacs et al., 1995), because distance learning requires more concentration than a face-to-face meeting (Kydd & Ferry, 1994). Therefore, interactive teaching styles become crucial to success (Nahl, 1993; Schwartz, 1995). Thus, we propose:

*Hypothesis 5. Students will experience more positive learning outcomes from technology-mediated distance learning with instructors who exhibit more interactive teaching styles.*

The instructor's control of the technology also should relate to learning outcomes (Dillon & Gunawardena, 1995; Leidner & Jarvenpaa, 1993; Lewis, Whitaker, & Julian, 1994). Distractions can result from the use of the equipment (Gowan & Downs, 1994), and students become impatient when instructors encounter technical problems (Leidner & Jarvenpaa, 1993). Further, Storck and Sproull (1995) found that people who interact only via video rely less on task competency and more on communication competency when evaluating others. Therefore, if it appears that instructors have little control over the communication technology used in distance learning, students may view them as being less competent overall. Thus,

*Hypothesis 6. Students will experience more positive learning outcomes from technology-mediated distance learning with instructors who exhibit more control over the technology.*

**Course characteristics.** The number of student locations can affect learning outcomes. One reason for this is that a physical gap between student locations can result in students' feeling cut off from one another; students need to be able to see and interact with as many other students as possible to build a class community (Nahl, 1993). For instance, the larger the number of locations participating in a videoconference, the lower the participants' impression of personal contact and ratings of the perceived benefits and advantage of the technology (Gowan & Downs, 1994).

More student locations will also result in more administrative tasks for instructors, such as checking each location for questions. More tasks translates into less time for the discussion of course content. Further, it is difficult to build discussion into distance learning courses that have three or more sites, because of the time it takes to switch between locations, interruptions, and the lack of more-than-two-way video (Catchpole, 1995 video conference), so teacher effectiveness declines (Wetzel et al., 1994). Therefore, we propose:

*Hypothesis 7. Students will experience more positive learning outcomes in technology-mediated distance learning courses with fewer student locations.*

**Student characteristics.** Students may feel more self-conscious in distance telelearning situations, and going on-camera may inhibit them (Nahl, 1993). For instance, instructors have noted that some students are reluctant to sit within the range of a camera (Burroughs, 1995; Nahl, 1993). When students' images are displayed on a monitor, the salience of self increases (Storck & Sproull, 1995), and students may feel that they are "on television" and thus participate less than they would in traditional learning situations.

Speaking in front of a camera may be a high-anxiety activity, and some students will be uncomfortable and intimidated (Nahl, 1993). Thus, we propose:

*Hypothesis 8. Students who are more comfortable when their images are displayed on a screen will experience more positive learning outcomes from technology-mediated distance learning.*

Finally, the social influence model of technology use (Fulk et al., 1990) suggests that classmates' (as well as instructors') attitudes will affect learning outcomes:

*Hypothesis 9. To the extent that classmates have positive attitudes toward the technology used in distance learning, students will experience more positive learning outcomes.*

## METHODS

### Background

We studied 29 of the 30 technology-mediated distance learning courses taught during two semesters by instructors at six North American universities (one instructor declined to participate, citing overwork). The courses were in accounting, chemistry, computer science, engineering, mathematics, physics, political science, and sociology and involved teaching people located in seven cities. The universities had implemented distance learning mainly at the graduate level to offer courses for which enrollments would not be sufficient to justify offerings at one location or for which qualified instructors were not available at particular locations. The average course size was 16 students and ranged from 4 to 36.

Two types of distance learning rooms were used by the universities: one type transmitted full-motion video, and the other transmitted compressed video. In addition to videoconferencing equipment and equipment for transmitting documents and videos, these rooms were equipped with computers that instructors could use to display material to students. Students generally had individual microphones; additionally, the instructor could put a room into a conference mode for discussions by activating all room microphones. Students viewed two screens at the front of the room, one screen might display a document, and the other, students at another location. Seating was arranged in traditional theater style. There were no camera operators in the rooms; instructors had to stand (or sit) at one of several fixed locations in the rooms to appear on screen. Instructors were usually expected to handle the equipment themselves, and technical support was not readily available; if instructors encountered technical problems, they had a list of technical support people whom they could telephone in the hope that one would be available.

We collected both quantitative and qualitative information. The quantitative information came from a questionnaire we designed to study the factors affecting outcomes of technology-mediated distance learning. As Leidner and Jarvenpaa (1995) suggested, researchers investigating such outcomes should draw upon well-established variables from education research, rather than create new variables; thus, we took measures from past research whenever possible. The questionnaire was tested for face validity: we received feedback from our university's teaching and learning office and from a university steering committee evaluating the distance learning rooms.

To administer the questionnaire, we attended a class in each course near the end of the semester and went on-line to local and remote students to request their completion of the questionnaire outside of class time. Completion of the questionnaire was anonymous, voluntary, and unrelated to the course grade. All students who were in class that day received questionnaires and were asked to return them to us in preaddressed envelopes. Questionnaires were returned by 247 students, representing a response rate of approximately 69 percent.

Multiple types of qualitative information were collected to help "triangulate" our findings. For the first semester, we observed at least one (and usually more than one) class meeting in each course. We traveled to local and remote sites to observe students' reactions. During our observations, we recorded our personal reactions (e.g., to video quality or teaching style) and our observations of students' behaviors (such as reading newspapers or taking notes). In addition, we informally interviewed students and instructors before and after classes and during breaks. At the end of the semester, instructors provided further feedback on their reactions through electronic mail. Finally, the student questionnaire included an area for open-ended comments.

To help validate our qualitative findings for the first semester, in the second semester we hired a graduate student in psychology who was unfamiliar with our hypotheses. She was simply told to write down her observations of students' behaviors and her personal reactions to the technology and to talk informally with students and instructors. To remain consistent with what we did in the first semester, we asked her to observe at least one class meeting in each course. She traveled to local and remote sites to observe students' reactions. As in the first semester, instructors provided further feedback on their reactions through electronic mail, and the student questionnaire included an area for open-ended comments.

We were also participant-observers in three short courses held in both types of distance learning room, and we observed a technology-mediated course taught to multiple locations as part of another university's executive management education program.

The final type of qualitative information was an independent report on a focus group consisting of instructors of the distance learning courses held at the end of the first semester by our university's teaching and learning office.

## Measures

On the questionnaire, we defined multimedia technology as “the two-way audio/video/graphic link used in this course.” Unless otherwise indicated, all items were measured on seven-point scales, with response options ranging from “strongly disagree” to “strongly agree.” Table 1 (in “Results”) gives internal consistency reliabilities (Cronbach alphas) for all scales.

**Dependent variables.** We did not have access to student grades, and thus, student performance was not included as a dependent variable in this study.

For *involvement and participation*, we created seven items, five of which were adapted from Fellers and Moon’s (1994) survey instrument. For example, one item stated: “As a student, I felt personally involved in the course.”

Alavi and colleagues (1995) argued that measures of *cognitive engagement* in the learning process need to be developed. However, Csikszentmihalyi’s (1975) motivational theory of flow, which describes individuals’ subjective experiences “characterized by perceptions of pleasure and involvement” (Webster, Trevino, & Ryan, 1993: 412), seemed to be appropriate to capture students’ cognitive engagement. Thus, for cognitive engagement, we used six items from Webster et al.’s (1993) flow measure, assessing the dimensions of attention focus, curiosity, and intrinsic interest and excluding items concerning individual control, since the instructor, not the students, controlled the technology. For example, one item stated: “This type of multimedia technology arouses my imagination.”

For *technology self-efficacy*, we adapted five items from Hollenbeck and Brief (1987), such as “I believe that I will be able to use this technology easily in the future.” This scale has demonstrated good reliability and validity in past research (e.g., Martocchio & Webster, 1992).

For *attitudes toward the technology*, we adapted items from Zoltan and Chapanis’s (1982) bipolar general attitudes scale and Chidambaram and Jones’s (1993) media perceptions questionnaire, creating a nine-item Likert scale. Students were asked, “To what extent do the following words or phrases appropriately describe the use of multimedia technology for classroom communication and education purposes?” Sample items include “effective,” “good,” and “dehumanizing.”

For the *usefulness of the technology*, we created three items, such as: “This type of multimedia technology interferes with communication in the classroom” (reverse-coded).

For *attitudes toward distance telelearning*, we created six items, three of which were taken from Fellers and Moon’s (1994) instrument. For example, one item stated: “I would recommend this type of distance learning course to someone else.”

For the *relative advantage of distance learning*, we created five items, one of which was taken from Skinkle and McLeod’s (1995) instrument. For

example, one item stated: "I do not believe that this type of Distance Education can ever be as good as face-to-face instruction" (reverse-coded).

**Independent variables: Technology characteristics.** For *reliability*, we created three items, two of which were adapted from Goodhue and Thompson (1995). For example, one item stated: "The technology was subject to frequent problems and crashes" (reverse-coded).

For *technology quality*, we created six items, two each for audio, video, and graphic qualities. Three items were adapted from Fellers and Moon's (1994) instrument, and one was adapted from Skinkle and McLeod's (1995) instrument. For example, one item for audio quality stated: "I could hear remote participants (the instructor and/or students) clearly."

For *perceived medium richness*, we used Webster and Trevino's (1995) eight-item measure based upon medium richness theory (Daft & Lengel, 1986). The measure included two items for each of the four dimensions of richness. The measure stated: "To what extent would you characterize multimedia (such as the technologies used in this course) as having the ability to. . . ." The eight items were then listed. For instance, one item, relating to feedback, was "give and receive timely feedback." Students responded on seven-point scales ranging from "not at all" to "to a very great extent."

To determine *location*, we asked: "Are you at: 1. a *remote* site (i.e., the course instructor usually is at another site), 2. a site in which the course instructor is *sometimes there*, 3. the *origination* site (i.e., the course instructor usually is at your site)?" The second category was needed because some instructors alternated between sites so that they could provide face-to-face contact at all sites.

We coded the courses with respect to *video type* as compressed video (0) or full-motion video (1), based on our knowledge of the technologies in the teaching rooms.

**Independent variables: Instructor characteristics.** Drawing upon social influence theory (Fulk et al., 1990, 1995), we adapted Webster and Trevino's (1995) one-item measure of social influence, which taps students' perceptions of *instructor's attitudes* regarding the usefulness of a medium. (Rice and Aydin [1991] argued that researchers should not ask subjects to rate others' attitudes because these ratings will more likely reflect the subjects' own attitudes than the others' attitudes. But if social influence theory is correct, perceptions of others' attitudes may be more important than their actual attitudes [Fulk et al., 1995].) The item stated: "Compared to traditional classrooms, how useful do you think your *instructor* considers Distance Education using this type of technology?" Students responded on a seven-point scale ranging from "not at all useful" to "very useful."

Three items adapted from Fellers and Moon (1994) captured *teaching style*. For example, one item stated: "The instructor encouraged student interaction."

To measure the instructor's *control over the technology*, we created four items, one of which was adapted from Fellers and Moon (1994). For instance, one item stated: "The instructor handled the equipment effectively."

**Independent variable: Course characteristics.** The *number of student locations* ranged from one to three. (For two of the courses, there was only one student location—that is, the course instructor was at one location, and all students were at another.)

**Independent variables: Student characteristics.** Two items were created to capture the students' *comfort with their images* on the screen, one of which was adapted from Skinkle and McLeod's (1995) instrument. For instance, one stated: "I was comfortable with the presence of my own image on the screen."

As for instructor's attitudes, we adapted Webster and Trevino's (1995) one-item measure of social influence tapping students' perceptions of *classmates' attitudes* regarding the usefulness of the medium. The item stated: "Compared to traditional classrooms, how useful do you think your *classmates* consider Distance Education using this type of technology?" Students responded on a seven-point scale ranging from "not at all useful" to "very useful."

## Analyses

Minimizing type I error (Dillon & Goldstein, 1984) requires an omnibus test when dependent variables may be correlated. Thus, for the quantitative data, we first tested hypotheses with an omnibus test, canonical correlation, incorporating all dependent and independent variables. (Hypotheses that did not relate to the dependent variables—3a, 3b, and 3c—were not so tested; see results for these hypotheses below.) If the results of an omnibus test are significant, it is then appropriate to conduct individual multiple regression analyses for each dependent variable, which we did.

For the qualitative data for the first semester, we recorded our observations and impressions as they occurred and placed them in a file. At the end of the semester, we independently read and reread our filed notes to gain an impression of the important influences on learning outcomes. At the end of the second semester, we asked our graduate student observer to read over all the qualitative data for both semesters and to come up with themes; no other direction was given on what these themes should look like. As reported below, her themes were remarkably similar to our conclusions.

## RESULTS

Descriptive statistics, including means, standard deviations, internal consistency reliabilities, and Pearson correlations, are reported for all quantitative measures in Table 1. The omnibus canonical correlation was significant (Wilks's lambda = 0.14,  $F = 7.79$ ,  $p < .001$ ). Table 2 presents results of the individual multiple regression analyses.

### Findings Related to the Hypotheses

For each of the hypotheses, we present both our quantitative and qualitative findings. Hypothesis 1, proposing that the reliability of the technology

employed would relate positively to learning outcomes, was supported for three outcomes on the questionnaire: attitudes toward the technology, usefulness of the technology (a marginally significant relationship), and attitudes toward distance learning. Our qualitative findings also support reliability as an influence on learning outcomes. On occasion, we observed that the technology could be unpredictable and difficult to get up and running. Further, it might crash or drop one of the sites. Students made remarks such as these: "The technology did not work part of the time; we lost 1–2 hours," "Due to the difficulties with the multimedia technology the learning process was less efficient," and "Sometimes the technical problems delayed the learning and we needed to reschedule a class." Similarly, one instructor told us, "We've had a technical problem every week," and the focus group concluded that "the system can shut down and end the class prematurely (or prevent a class from even starting)." Finally, one of our observer's themes was "technology breakdowns."

Hypothesis 2, proposing that technology quality would relate positively to learning outcomes, was supported by the questionnaire results for technology self-efficacy (marginal), attitudes toward the technology, attitudes toward distance learning, and the relative advantage of distance learning. Our qualitative findings provide evidence for these findings. Many of our discussions with students in these classes dwelt on audio, video, and graphics quality. In some classes, transmissions were slow, leading to delays and time lags in signals and resulting in a choppy audio signal. For instance, one student said that there were "lots of interruptions due to the half-second delay; mostly, the professor interrupts the students." Another said that "lag-time is a pain due to the interruptions it causes," and another that "the delay is a drag for communicating." Similarly, one instructor stated: "Audio and video lag times are major contributors to my aversion to, and annoyance with, the system," and another remarked: "I never know what the people at the other end are seeing, if it's clear to them or what." Students also remarked on graphics quality, for instance: "Overheads tend to lose color and resolution."

We observed that remote students past the second row appeared small on the screen displayed at the front of the room and noted that we couldn't tell who was talking at the other end. Students also commented on their inability to see which student was asking a question at the other end. They recognized that this would be a problem for the instructor; an exemplary statement was "Students' raised hands are difficult for the professor to see." Finally, our observer noted "quality of technology" as a theme.

Hypothesis 3a, proposing that students would perceive the distance learning technology to be less rich than traditional, face-to-face instruction, was tested indirectly with the quantitative data. More specifically, we compared students' average ratings for perceived medium richness (4.44; see Table 1) with the average ratings found in other research for face-to-face meetings (4.76, converted from 3.40 on a 5-point scale; Trevino, Webster, & Stein, 1996); perceived richness is higher for face-to-face meetings.

Our qualitative results support this difference. As one local student

TABLE 1  
Descriptive Statistics, Reliabilities, and Correlations<sup>a</sup>

Variable	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Reliability	4.13	1.44	(.86)																	
2. Technology quality	4.28	1.01	.43	(.70)																
3. Location	2.06	1.10	.11	.15	(N.A.)															
4. Video type	0.69	0.46	.24	.22	.33	(N.A.)														
5. Perceived medium richness	4.44	0.94	.28	.44	.15	.13	(.84)													
6. Instructor's attitudes	5.44	1.08	.22	.24	.02	-.03	.28	(N.A.)												
7. Teaching style	5.30	1.10	.19	.21	.06	-.12	.21	.20	(.77)											
8. Control over the technology	4.69	0.96	.52	.39	.04	.12	.37	.21	.37	(.68)										
9. Number of student locations	1.95	0.44	-.10	-.07	.32	.18	-.08	-.02	-.24	-.14	(N.A.)									
10. Comfort with image	4.52	1.29	.12	.16	.04	.06	.18	.17	.20	.18	.00	(.61)								
11. Classmates' attitudes	4.81	1.25	.38	.35	.05	-.09	.46	.62	.29	.36	-.14	.16	(N.A.)							
12. Involvement and participation	4.23	1.20	.26	.31	.07	-.08	.47	.34	.52	.38	-.28	.37	.48	(.87)						
13. Cognitive engagement	3.93	1.01	.30	.29	.10	-.08	.49	.34	.42	.44	-.14	.26	.48	.69	(.82)					
14. Technology self-efficacy	4.98	1.00	.27	.37	.01	.02	.48	.38	.28	.30	-.21	.28	.44	.65	.52	(.81)				
15. Attitudes toward the technology	4.38	1.06	.53	.51	.13	.03	.58	.41	.38	.55	-.19	.24	.54	.65	.63	.63	(.88)			
16. Usefulness of the technology	3.86	1.19	.43	.45	.09	.06	.57	.35	.27	.52	-.10	.31	.46	.61	.63	.51	.67	(.77)		
17. Attitudes toward distance learning	4.75	1.29	.46	.50	.08	-.02	.56	.45	.45	.50	-.18	.29	.62	.74	.71	.65	.77	.68	(.92)	
18. Relative advantage of distance learning	4.05	1.25	.36	.43	.10	.00	.52	.38	.31	.44	-.24	.35	.47	.72	.59	.60	.67	.65	.76	(.79)

<sup>a</sup> All *r*'s > .12 are significant at *p* < .05. "N.A." = not applicable. Reliabilities (Cronbach alphas) are in parentheses.

TABLE 2  
Results of Regression Analyses<sup>a</sup>

Independent Variables	Hypothesis	Involvement and Participation	Cognitive Engagement	Technology Self-Efficacy	Dependent Variables		
					Attitudes toward the Technology	Usefulness of the Technology	Attitudes toward Distance Learning
Reliability of the technology	1	-0.01	0.01	0.02	0.21***	0.12†	0.11*
Quality of the technology	2	0.00	-0.05	0.11†	0.12*	0.09	0.14**
Perceived medium richness	3d	0.25***	0.28***	0.29***	0.29***	0.33***	0.23***
Instructor's attitudes	4	0.06	0.06	0.17*	0.12*	0.09	0.14*
Teaching style	5	0.32***	0.22***	0.06	0.12*	0.01	0.19***
Control over the technology	6	0.04	0.16*	0.00	0.16**	0.22***	0.04
Number of student locations	7	-0.15**	-0.01	-0.15**	-0.07	-0.01	0.10†
Comfort with image	8	0.21***	0.10†	0.15**	0.05	0.15**	-0.16**
Classmates' attitudes	9	0.16*	0.19**	0.09	0.10	0.07	0.20***
F		26.54	18.65	15.14	37.76	25.07	23.01
Adjusted R <sup>2</sup>		0.50	0.41	0.36	0.59	0.48	0.60

<sup>a</sup> Values are standardized regression coefficients.  
†  $p < .10$   
\*  $p < .05$   
\*\*  $p < .01$   
\*\*\*  $p < .001$

remarked, there is “less eye contact by the professor with the audience as he is busy concentrating on the monitor and the lecture notes and screening the off-site classroom.” Instructors found it difficult to be as involved with the students during lectures as they would have been in a traditional course. For instance, the focus group concluded that “instructor contact with students is not as direct and requires instructors to watch and look at various media (i.e., look at the camera and monitors often).” Other instructors made these remarks: “It’s hard to monitor all the technical stuff and lecture too.” “There is the danger that the ‘technology’ is interfering with the lecture material, i.e., I had to keep reminding or asking myself whether I had ‘sent’ the information, were the students seeing me and the ‘live’ document, etc.,” and “My biggest complaint about the system is the chilling effect it has on the ‘live’ audience; I felt cut off from them by my need to ‘play’ to the camera; I felt that my own local class was seriously compromised by this system and did not get what I can usually give them in this course.” Finally, one of our observer’s themes was “the environment is stiff, sterile, and impersonal.”

We observed that students seemed more detached than they generally do in traditional face-to-face instruction at *both* local and remote sites. We wrote the following in our notes: “It’s like he’s behind a barrier; the equipment separates him from the class, like he’s not actually there.” Students also made comments such as these: “The technology distracted me” and “It was distracting shifting views between the professor, the other classes, the overheads, and the computer screen.” We observed students exhibiting detached behaviors such as sitting back, leaning their faces on their hands, and looking down rather than up at the instructors or their on-screen images. Finally, our observer noted about one instructor that “the prof looks *ONLY* at the overhead—not at the students at all. He probably wouldn’t notice if the students got up and left.” Concerning another instructor, she noted this: “I got the feeling that the machines and the equipment are acting like a wall between the prof and the students. The prof is using his machine and focusing on his stuff; the students are focusing on their stuff and their machines. There’s a real ‘distance’ between them.”

Hypothesis 3b, proposing that students at origination sites would perceive the technology to be richer than those at remote sites, was tested by correlating location with perceived medium richness ( $r = .15$ ,  $p = .02$ ). The qualitative results support a relationship between richness and distance. Students felt it was a disadvantage to be at a remote site. As one student at a local site remarked, “It was awkward communicating with the other class; we [the group here] never bonded with the other class.” Students stated that remote students were limited by having to watch and hear the instructor through the system. One noted this: “I felt like [I was] sitting in a church for a sermon. The distance between the instructor and students seems to be so large.” Many students pointed out the difficulties in contacting an instructor outside of class hours if he or she were at another site: “I don’t like the professor being at another location—it’s hard to get help” and “There is an advantage to being local; students can interrupt easier or can ask questions after class.”

In several courses, students from a remote site traveled to be part of the face-to-face class; they felt that the advantage of being at the same location as the instructor outweighed the disadvantage of the commute.

Instructors remarked that few communication cues came from the remote sites. As one noted, "The instructor loses direct eye contact with the students at the remote site. By observing the reactions of the students, I can detect whether they have grasped the material, and I will invite questions if I feel they didn't understand. I did not seem to have the same intimacy and interaction with students at the remote site." Similarly, another instructor stated:

I generally have good rapport with my classes; I watch the students very carefully as I lecture and adjust my pace/material/style to the way they react. After ten years of lecturing, I can generally read my classes very well. The biggest shock to me was how much this classroom scenario interfered with this. The remote class felt somehow—I'm having problems picking the right word here—unreal. A lot of the normal cues I rely on, low-level sounds, fine facial expressions, were completely lost in the transition.

Instructors often (unknowingly) lowered the richness of their communication to remote sites by reducing communication cues in several ways. Some made little eye contact with the remote students; we often observed instructors "looking" at the remote site by gazing at the screen displaying the remote students rather than by looking at the camera. Thus, remote students viewed the top or side of the instructor's head when he or she was speaking directly to them, which reduced their "feeling of inclusion" in the course, as one instructor noted. In other courses we viewed, the arm of the document equipment partially hid the instructor's face from the remote students, again reducing communication cues. Finally, two of our observer's themes signal the importance of location: "location—remote or local" and "accessibility of prof: reduced communication."

We quantitatively tested Hypothesis 3c, proposing that students in courses using full-motion video would perceive the technology to be richer than students in courses using compressed video, by examining the correlation between video type and medium richness ( $r = .13$ ,  $p = .05$ ). Participants in the compressed-video courses were more likely to mention time lags in audio and video. For instance, students remarked on the "staggered communication," and instructors noted that "the quality of the transmission needs to be upgraded." In contrast, none of the focus-group professors using full-motion video mentioned this.

Hypothesis 3d, proposing that perceived medium richness would relate positively to learning outcomes, was supported for all outcomes on the questionnaire. Many of our qualitative findings relating to medium richness concerned feedback and nonverbal cues. For instance, one student remarked that there is "not much potential for feedback between professor and students." Many noted lost body language cues. For example, students stated,

"It's bad 'cause you can't see body language" and "You don't get facial reactions when presenting over video." Similarly, instructors commented, "It's hard to see body language."

Our qualitative findings are consistent with Fulk and colleagues' (1990) notion that medium richness can be partially subjective and partially objective. Supporting its subjectivity are these comments of students who were asked the difference between distance learning and face-to-face instruction: "I hate it; it's not as interactive," "I zone out (like watching TV)," "[It] feels like watching TV so my attention span seems to go down," "There was something lacking in the social interaction that exists in a traditional classroom," "not as spontaneous," and "slower feedback." In contrast, others said: "It works as well as a normal class," "The system is very similar [to face-to-face instruction]," and "There's no effect."

In support of the objectivity of medium richness, we observed that not all instructors used all media. For instance, in one course we observed an instructor moving from a conference-style discussion with both sites, to a demonstration of a multimedia software system, to an examination of information on the World Wide Web, to student presentations, all in the same class period. In another course, we observed an instructor spending the whole period "walking through" printed class notes (which had been distributed earlier to students) that he displayed through the document camera. Therefore, although multiple media were available to instructors, the number they used varied, leading to objective differences in medium richness.

Hypothesis 4, proposing that instructors' attitudes toward the technology would relate positively to learning outcomes, was supported by questionnaire results for technology self-efficacy, attitudes toward the technology, attitudes toward distance learning, and the relative advantage of distance learning. Our qualitative findings provide some justification for differences in instructor attitudes. For instance, we observed an instructor who demonstrated very little patience with the technology and who would easily give up when faced with technological problems. Instructors also mentioned their frustration with physical limitations resulting from the technology. They remarked that remaining in camera range restricted their movements, and those in the focus group noted that "instruction became less physically animated." Students noticed this: "It really limited the teacher to the immediate area of the console; he was unable to roam the room or use a chalkboard." Many instructors mentioned that they needed extra preparation time to teach using these technologies, covered less course material in class, and did not receive any additional compensation (such as teaching relief or assistants) for teaching in these rooms, all factors that could result in negative attitudes. Finally, when we asked one instructor what advice he would give to others planning to use the technology, he said: "Stay away from it—students benefit much less than in a traditional setting."

Hypothesis 5, proposing that more interactive teaching styles would relate positively to learning outcomes, was supported for involvement and participation, cognitive engagement, attitudes toward the technology, and

attitudes toward distance learning. Our qualitative findings corroborate that teaching styles and their effects on learning outcomes differed. For instance, we observed instructors who spent the whole class period lecturing to students from the front of the classroom (with only the instructors' personal microphones turned on) and who only asked for questions from students at the end of a section of material. In contrast, we observed other instructors who sat in the audience with the local students and conducted highly interactive discussions between the sites, with room microphones turned on.

Students in more interactive courses had more positive attitudes. For example, students remarked: "The presenter's style definitely has a lot to do with the acceptability of the class situation," "The system works without many problems because he's a good lecturer and because he makes it a participation course," and "The presentation style of the professor and the professor's ability to handle the equipment are the major factors." In contrast, in less interactive courses, students made comments like: "He would be just as good videotaped." Similarly, one instructor stated:

I think it is important that the students at the remote site(s) see the instructor. I do not think there is anything worse than looking at a "live image" transmitted via the document camera with a finger pointing at some aspect of an equation or graph throughout the entire lecture. The students need to see something of the instructor and vice-versa.

Similarly, the focus group members suggested this: "Avoid lecture-only classes since the students are not likely to find them engaging." Finally, our observer noted "teaching style" as a major theme. Of a less interactive class, she wrote that "this class is just one overhead after the other—BORING!" and of a more interactive class, "this prof talks 'to' the students, not the screen—there is a very different feel with this, it's more natural, you feel like you are involved in the class."

Hypothesis 6, proposing that instructor control of the technology would relate positively to learning outcomes, was supported for cognitive engagement, attitudes toward the technology, usefulness of the technology, attitudes toward distance learning (a marginal relationship), and the relative advantage of distance learning. In some of the rooms, we observed that it was easy to get the sites up and running and connected. In others, it was more difficult to establish a connection, and one or more connections might drop during a class. These differences could lead students to believe that some instructors had less control over the technology than others. And, as described above, students highlighted the instructor's ability to handle the equipment as a key factor. Another student remarked: "I think it makes a difference with respect to how familiar the prof is with the equipment and how comfortable they feel with it. If the prof is anxious and uncomfortable, then it generalizes to everything else." Similarly, the focus group concluded: "Learn how the videoconferencing system works—be comfortable with it."

Hypothesis 7, proposing a negative relationship between the number of student locations and learning outcomes, was supported for involvement

and participation, technology self-efficacy, and relative advantage. Our qualitative findings also support this negative relationship. We concluded that the greater the number of locations, the greater the process losses owing to efforts to maintain contacts. For example, we observed one instructor thus trying to elicit feedback from each location: "Any questions from [location1]?" . . . no answer . . . "[location1]?" . . . no answer . . . "[location 1]? Are you there?" . . . the location finally answers. As our observer noted,

I get the feeling that it's hard for the students to speak up because (with three locations) no one knows if someone else is trying to get through (due to the lag time) and there just seems to be this hesitancy and tentativeness among the students as they are all sort of looking at each other and no one knows if they should speak up or not.

We also observed process losses owing to sites' communicating at the same time: an instructor would ask for questions, there would be a delay while students would decide whether to respond, and then people at multiple sites would talk at the same time.

Hypothesis 8, proposing a positive relationship between students' comfort with their images on the screen and learning outcomes, was supported for involvement and participation, cognitive engagement (marginal), technology self-efficacy, usefulness of the technology, attitudes toward distance learning, and its relative advantage. Our qualitative findings are consistent with these results. For instance, many students remarked that they were nervous about asking questions: "I don't like the technology; I feel like I'm being broadcast if I speak, so I don't," "I was hesitant to speak over the microphone to ask questions," and "I was sometimes timid about asking questions for fear of embarrassing myself in front of people I don't know." Similarly, one instructor noted that students were "clearly intimidated to ask questions," and others remarked that students did not ask as many questions as in a traditional class. Some students "hid" at the back of the room. For instance, in one class we observed, several remote students sat at the very back of the room (far away from the other students, who were near the front), making it very difficult to see them. We mentioned this to the instructor, and he said that he had been trying to encourage these students to move up into better camera range for the whole semester, without success. Further, in one course students told us that the technology had scared off many students: one location dropped to 4 students from 14. Finally, "inhibited—fear of asking questions" was one of our observer's themes.

Hypothesis 9, proposing a positive relationship between classmates' attitudes and learning outcomes, was supported for involvement and participation, cognitive engagement, and attitudes toward distance learning. In our qualitative data, there were few student remarks on classmates' attitudes. However, we observed the powerful effects that peers' attitudes could have. For example, we were discussing the technology with a student who was expressing positive attitudes toward it. Another student who joined us proceeded to make several negative comments about the system. These com-

ments had a fairly strong effect on the first student, who eventually began to agree with the second one, contradicting his earlier statements.

### **Findings Unrelated to the Hypotheses**

In addition to the findings relating to the hypotheses, two other key observations arising from the qualitative data merit attention—specifically, comparisons of outcomes for remote and local students, and students' appreciation for the distance learning technology.

First, although location demonstrated little relation to distance outcomes (see Table 1), the qualitative results paint a different picture. For instance, we noted very different "audience behaviors" at remote sites. Students at remote sites did not act as if they were as involved in the courses. Some talked among themselves about other issues, some read newspapers, and some wandered in and out of the classrooms at will; we even observed students spending the better part of a class playing with orange peels, examining their split ends, and writing on the bottoms of their shoes. Such behavior may be due in part to the fact that the instructor can monitor at most two sites at any one time (the local and one remote site); thus, for courses with three sites, at least one remote site was not being monitored at all times. Even with two sites, the students probably (correctly) felt that the instructors were not monitoring them most of the time but were focusing on the delivery of course material and on the technology itself (as described above). As students remarked, "My mind wandered too much; not having the prof here didn't make me pay attention," "It was a little easier to misbehave when the instructor was not in the room," and "I can't read a book if a prof is before me—I'm too embarrassed to." We observed that it was as if the small remote classes had turned into large lecture classes in terms of accepted student behaviors. Students also had this reaction: "It takes a small class and gives it the ambience of a huge lecture hall. The prof feels about that far away and I'm about that likely to ask questions." Finally, our observer noted that "students in the remote location are either sleeping or gazing elsewhere" and "I feel a difference in the tone of the class when I am in the same location as the prof. I feel more connected with the class."

Second, many students clearly recognized the advantages of distance learning technologies. They remarked on access to outside experts (professors), a wider selection of courses, interaction with students at other universities, and the opportunity to gain experience with the technologies. With respect to access to other professors, students noted "access to two excellent professors who aren't here," "gaining exposure to professors and other universities otherwise unavailable," and ability "to learn the material from experts in the field" as advantages. Students also appreciated the opportunity to choose from a wider selection of courses: "good for people who would not otherwise be able to take this course" and "I got to take a course that was not offered at my university." Concerning interactions with peers at other locations, remarks included: "met people from remote location, different backgrounds," "allowed alternate views of students not at XXX to be

included in our class,” and “the ability to get input from students from XX and XXX at the same time and exchange ideas.” With respect to the advantages of learning about these emerging technologies, students made remarks such as “exposed to new technology,” “let me understand the use of the technology,” and “it’s great to be able to take advantage of this type of technology.” Finally, our observer noted three themes related to students’ perceptions of the advantages of these technologies: “course availability,” “exchange ideas/interaction with students at other universities,” and “exposure to new media.”

## DISCUSSION AND IMPLICATIONS

All influences on technology-mediated distance learning outcomes related to at least three of the seven outcome variables. Perceived medium richness related to all seven outcome variables. Thus, to the extent that instructors can exploit the full richness of the media available to them, students should experience more positive learning outcomes. Further, since medium richness is partially perceived, instructors can exhibit attitudes and behaviors that are consistent with a rich medium.

Other key influences on outcomes were students’ comfort with their images on the screen (relating to six outcomes), instructor control over the technology (relating to five outcomes), and the quality of the technology, instructor’s attitudes, and teaching style (all relating to four of the seven outcomes). Thus, in practice, instructors should build in opportunities for students to become comfortable with the technology employed for distance learning, learn to control the technology, project positive attitudes, and use interactive teaching styles.

Past research has demonstrated the importance of involvement and participation to traditional teaching, and our study supports this notion for technology-mediated distance learning. The most important influence on involvement and participation was teaching style. Similarly, when asked what advice they would give teachers using such technology for the first time, instructors also highlighted the importance of an interactive teaching style: “Think about ways of keeping the students involved,” “Elicit participation by using the discussion mode frequently,” “Use the conference mode early in the term to get students introduced at all sites,” and “Try to motivate the students to ask questions/stimulate discussion.” In sum, these results suggest that instructors need to make additional efforts to involve both local and remote students in the distance learning process.

## Limitations

Field research like this study of distance learning courses taught during two semesters has many limitations. One limitation was the lack of control groups; we could not compare our results with those for the same instructors teaching in traditional classrooms or with those for distance education courses that did not have multimedia communication systems. Further, we

had no control over other aspects of the study, such as the subject matter of courses, the number of student locations, or the number of students. Latchem and colleagues (1994) showed that videoconferencing worked best when fewer than 30 people were on a site. However, we could not compare smaller and larger sites; our courses averaged 16 students. In addition, some of the variables that we would have liked to include in our analyses were partially confounded with others. For example, we would have liked to include course subject matter and instructors' and students' experiences with technology-mediated distance learning, but these variables were related: in our sample, courses in the sciences were more likely to have instructors and students with previous distance learning experiences. Additionally, our questionnaire results were subject to common method bias. As Alavi and colleagues (1995) pointed out, these issues present barriers to this type of research, and qualitative methods may be helpful when experimental and baseline manipulations are not possible. Our qualitative observations and interviews helped to overcome some of these limitations.

### **Implications for Practice and Research**

Videoconferencing technologies have diffused dramatically in organizations since the late 1980s (Hart, Svenning, & Ruchinskas, 1995). Distance learning courses provide students with experience in these emerging technologies, and students in this study recognized the benefits of such exposure. They also appreciated the access to outside experts they gained and the opportunity to interact with peers at other sites.

Results of our study can provide initial recommendations to administrators on the characteristics of successful technology-mediated distance learning courses; these include use of rich media, few student locations, and instructors who project positive attitudes, employ interactive teaching styles, and help students become comfortable with having their images displayed on a screen. As medium richness was the most powerful predictor of learning outcomes, administrators should explore a variety of methods to increase students' perceptions. Our findings suggest that simple changes could be made to increase perceptions of medium richness, including: (1) providing camera and technology layouts to ensure that instructors maintain eye contact with both local and remote audiences, (2) encouraging instructors to use the variety of media available, to eliminate teaching by methods like the pointing finger on the document, and (3) training instructors not to focus on the technology at the expense of students. Further, courses in which the technology is reliable, of high quality (little delay in audio and video signals is particularly important), and in which the instructor demonstrates control over the technology will tend to be more successful. Training instructors about the technology and the importance of a participative style of teaching and providing an adequate technical support staff will help to alleviate some of these concerns. Very useful guides concerning training and support are available to administrators (e.g., Lochte, 1993).

Study results also have significant practical implications for ratings of

professors' teaching effectiveness. In most universities, student evaluations are key inputs into promotion and tenure reviews. If professors are generally evaluated more negatively in technology-mediated distance learning courses, review committees will need to take this into account. Further, administrators may want to draw on those professors who are evaluated positively in these courses as mentors and trainers for others.

More controlled studies using comparison groups and baseline measurements will help to extend this line of research. Other avenues for future research include longitudinal studies, which might relate students' expectations for distance learning to learning outcomes. Further, we tested only one-way influences on teaching effectiveness, but feedback loops occur; for example, students' attitudes toward technology-mediated distance learning at the end of a semester may affect their comfort levels with their displayed images in subsequent courses. Future researchers may also want to more carefully delineate the range of dependent variables that are key to distance learning. For instance, our dependent variables, although conceptually distinct, were highly intercorrelated. Also, we did not have access to students' course grades or instructors' teaching evaluations, and administrators may be interested in more objective outcome measures.

More generally, models of teaching effectiveness in distance learning should be augmented to encompass further influences, including technical characteristics (such as the number of media used), student characteristics (such as extraversion-introversion; Dillon & Gunawardena, 1995), course characteristics (undergraduate versus graduate), and instructor characteristics (past training and experiences with technology, or past teaching evaluations). For example, the common wisdom is to have distinguished or popular teachers "teach on TV" (Walsh & Reese, 1995). However, will the teachers conventionally deemed best remain the best when they teach via videoconferencing?

Other important issues for practice and research include the design of distance learning environments (Ellis, 1992), emerging technologies supporting distance education (cf. Burroughs, 1996; Cutkosky, Tenenbaum, & Glicksman, 1996; Harasim, Calvert, & Collings, 1996; Soloway, 1995), and cross-cultural implications of technology-mediated distance learning for underserved areas of the world (Utsumi, Boston, Klemm, & Miller, 1997). Further, administrators may want to consider using distance learning technologies for other applications, such as delivering training and courses directly to corporations, conducting multicampus faculty and committee meetings, and publicizing and marketing their universities (Latchem et al., 1994; Walsh & Reese, 1995). These initiatives will help propel schools of business into the 21st century.

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